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N91-28209

AFSC

AIR FORCE SYSTEMS COMMAND

SPACE SYSTEMS PROPULSION TECHNOLOGY

by: Dale Hite

NEEDS

- **FULL OPERATIONAL USE OF SPACE DICTATES MULTI-PURPOSE VEHICLES THAT ASSUME:**
 - **MILITARY RESPONSIVENESS**
 - **RELIABILITY/MAINTAINABILITY**
 - **SUPPORTABLE LOGISTICS**
 - **TECHNOLOGICAL INNOVATION**

ELEMENTS

- **SSTO**
- **ORBIT TRANSFER AND MANEUVERING**
- **REVOLUTIONARY CAPABILITY**

CHEMICAL PROPULSION

- **MODULAR STORABLE PROPULSION - 8,000 TO 10,000 LBM TO GEO; IMBEDDED MANEUVERING PROPULSION PACKAGING FLEXIBILITY AND UNLIMITED RESTART - BY FY 92**
- **ROCKET ENGINE MATERIALS - 50% WEIGHT REDUCTION WITH ELIMINATION OF CORROSION AND WEAR LIMITS ON RELIABILITY AND COST - BY FY 93**
- **CRYOGENIC ENGINE TECHNOLOGY - 13,000 TO 15,000 LBM TO GEO - BY FY 93**

MODULAR/STORABLE ORBIT TRANSFER/MANEUVERING PROPULSION

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FEATURES

- **HIGH PERFORMANCE STORABLE ENGINES (XLR-132)**
- **MODULAR, COMPACT PROPELLANT FEED SYSTEMS**
- **PAYLOAD INCREASE TO GEO**
 - 45% WITH TITAN IV/TUS
 - MORE THAN 75% WITH SHUTTLE
- **40% MORE MANEUVERING CAPABILITY FOR SURVIVABILITY**
- **50% VOLUME SAVINGS**

TRANSITION TARGETS

- **10K CLASS ELV UPPER STAGES**
- **GPS, DSCS, DSP (BLOCK CHANGES)**

CRYOGENIC OTV PROPULSION

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FEATURES

- **29% MORE PAYLOAD VOLUME THAN CENTAUR G' (40 FT PAYLOAD)**
- **CAPABLE OF 30 DAY HOLD IN LEO**
- **ENABLE 40% PAYLOAD INCREASE TO GEO**

TRANSITION TARGETS

- **13K+ CLASS ELV UPPER STAGES**

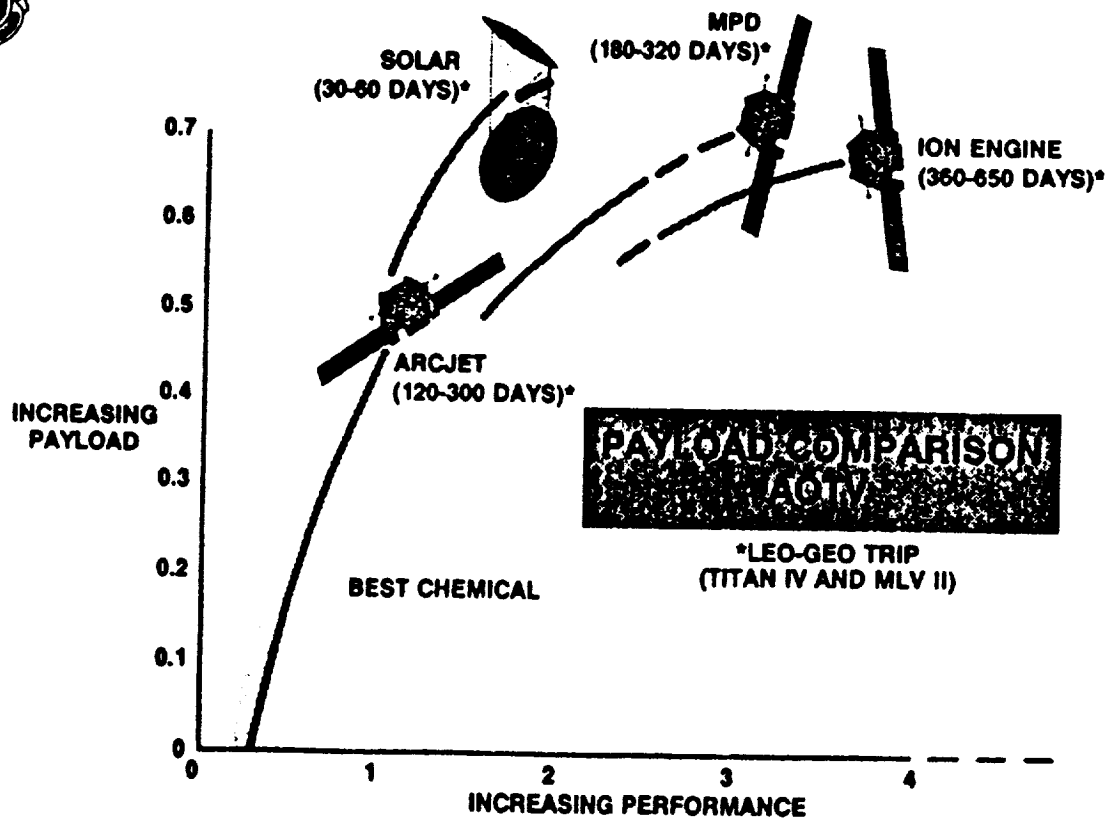
ADVANCED PROPULSION

ADVANCED SPACE PROPULSION

- **ELECTRIC PROPULSION - ARCJET 60 TO 100% INCREASE IN PAYLOAD; 12,000 LBS OFF TITAN AND 5,000 LBS OFF ATLAS - BY FY 2000**
- **ELECTRIC PROPULSION - MAGNETOPLASMA DYNAMIC THRUSTER - BY FY 2025**
- **SOLAR PROPULSION - 26,000 TO 45,000 LBS FROM LEO TO GEO, SHUTTLE LAUNCH; ELIMINATES SOLAR ARRAY PROBLEMS - BY FY 2010**



PAYLOAD AND TRIP TIME



ELECTRIC VERSUS CHEMICAL PROPULSION

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ELECTRIC (30KWe ARCJET)

- **PROPELLANT CONSUMPTION 1/2 TO 1/3 THAT OF CHEMICAL**
- **LARGE POWER SOURCE REQUIREMENT**
- **FIVE MONTH TRANSFER TIMES**

CHEMICAL

- **HIGH PROPELLANT CONSUMPTION**
- **STORED CHEMICAL ENERGY SOURCE**
- **SHORT TRANSFER TIMES**

HIGH ENERGY DENSITY MATTER

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IDENTIFICATION AND SYNTHESIS

- **IN-HOUSE CENTER OF EXCELLENCE - CONTINUING EFFORT**

PROPELLANT DEVELOPMENT - FY 2005

- **DOUBLE PAYLOADS**
- **REDUCE ROCKET SIZE BY 50%**
- **SINGLE STAGE TO ORBIT**

OTHER TECHNOLOGY BASE ACTIVITIES

- **DoD CRITICAL TECHNOLOGIES LIST**
- **AFOSR/NC**
- **NASA LEWIS**
- **WRDC/POOC**

NUCLEAR PROPULSION

NUCLEAR UPPER STAGE OFF ATLAS II

- **TECHNOLOGY DEMONSTRATED**

- ACHIEVED ASSEMBLY OF POWER SYSTEM AT SANDIA
- MEASURED POWER SYSTEM HEATING RATES AT BROOKHAVEN
- DEMONSTRATED STRUCTURAL INTEGRITY OF POWER SYSTEM AT LOW POWER AND NOMINAL TEMPERATURES

- **PAYOFF**

- 400% INCREASE OVER CENTAUR G OFF ATLAS II

SPACE LAUNCH PROPULSION

SSTO PROPULSION TECHNOLOGY

- **ALTITUDE COMPENSATING NOZZLE - 15 SECOND ISP GAIN AND 35% PAYLOAD GAIN - BY FY 91**
- **ADVANCED MATERIALS FOR NASP PROPULSION SYSTEM - \$30M COST SAVINGS, 2,000 LB WEIGHT SAVINGS - ELIMINATE POTENTIAL ENVIRONMENTAL CONCERN - BY FY 92**
- **LONG LIFE COMBUSTION CHAMBER - 300 CYCLES - BY FY 92**
- **INJECTOR SPRAY CHARACTERIZATION:**
 - MANIFOLD AND ORIFICE HYDRAULICS - BY FY 91
 - ATOMIZATION AND MIXING - BY FY 92
 - SECONDARY DROPLET BREAKUP - BY FY 93
 - SUPERCRITICAL VAPORIZATION - BY FY 94

ADVANCED LAUNCH DEVELOPMENT PROGRAM TECHNOLOGIES AT AL

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FEATURES

- **ALTERNATE PYROTECHNICS**
- **LOW COST EXPENDABLE CRYOGENIC TANKS**
- **CLEAN PROPELLANT DEVELOPMENT**
- **SOLID PROPULSION INTEGRATION AND VERIFICATION**
- **NON-DESTRUCTIVE EVALUATION OF SOLID ROCKET BOOSTERS**
- **LOW COST EXPENDABLE LOX/H₂ ENGINE DEVELOPMENT**
- **ROCKET ENGINE CONDITION MONITORING**

AL SUPPORT TO NASP

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AIR FORCE SYSTEMS COMMAND

TECHNICAL MANAGEMENT

- **ROCKET PROPULSION TECHNOLOGY**
- **ONE CO-LOCATED AL ENGINEER WITH JOINT PROGRAM OFFICE**

TECHNICAL SUPPORT

- **AIR BREATHING ENGINES**

PLANNING SUPPORT

- **FEED SYSTEMS AND TURBOPUMPS**

POTENTIAL SUPPORT

- **TESTING FACILITIES AND FLIGHT TESTING AT AFFTC**

PRESENTATION 1.3.6

UNMANNED LAUNCH VEHICLES / UPPER STAGES

